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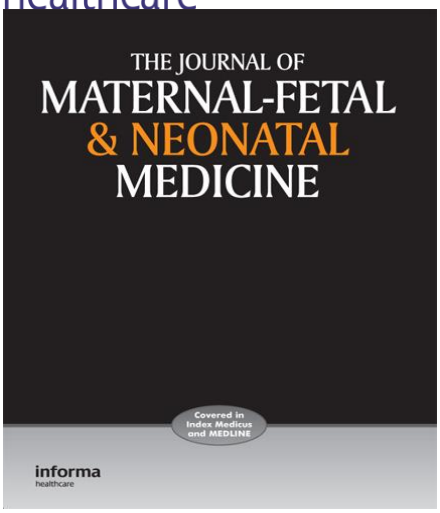

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How an extended Perinatal Audit may improve Perinatal Policy.

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Abstract

Objective: A perinatal audit has the intention of quality of care improvement based on analysis of perinatal death, with our without analysis of maternal morbidity and/or mortality. Additional analysis of cases of intrapartum asphyxia could provide more insight into ways to improve quality of perinatal care.

Methods: Analysis of cases of perinatal death and asphyxia in Jan Yperman Hospital, Ieper, Belgium, in 2012.

Results: Three perinatal deaths occurred, none were preventable. Nineteen cases of proven metabolic acidosis have been identified. Three cases are considered possibly preventable, four cases are considered preventable. In three (possibly) preventable cases, fetal monitoring was absent during the active second stage of labour. In two preventable cases, intervention following a significant ST event in the second stage of labour was delayed. In one case intervention was delayed in the first stage of labour, while in another, indicated operative delivery in the second stage wasn't conducted.

Conclusions: Integrating intrapartum asphyxia in the perinatal audit gives an opportunity to identify and eliminate weak points in the perinatal care chain, thereby optimizing quality of care. Lessons learned from our internal audit are the value of fetal monitoring and adequate action on significant ST events during second stage of labour.

How an extended Perinatal Audit may improve Perinatal Policy.

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1 Introduction

2 A perinatal audit is a structured critical analysis of the quality of perinatal care,

3 including diagnostic procedures and treatment, the use of facilities, and the resulting

4 outcome and quality of life of women and their children [1]. It compares ongoing activities

5 with an agreed standard, leading to the identification and utilization of opportunities for

6 bringing practice closer to that standard. Standard practice should be based on evidence

7 from research or, in the absence of evidence, by a consensus based on best clinical

8 judgment, within the context of local resources and skills [2].

9 Perinatal audits evaluate crude or cause-specific perinatal mortality, reviewing secular

10 trends over several years or comparing rates between similar institutions [2]. The purpose

11 of the perinatal audit is to recognize preventable deaths, and therefore improve perinatal

12 care. It will improve teaching and the collaboration in the perinatal chain, as it will yield

13 recommendations for local guideline development [1]. A perinatal audit may in- or exclude

14 cases of maternal morbidity and/or mortality.

15 Two commonly used perinatal process audits are topic audits and sentinel event audits.

16 Topic audits review a specific care activity for all patients. Sentinel event audits analyse

17 the process of care in a case with a defined adverse outcome. Traditionally, maternal and

18 perinatal death are used as sentinel events. We think it could be valuable to include

19 intrapartum asphyxia in the perinatal audit, so that avoidable asphyxia can be identified,

20 lessons can be learned, and measures taken.

21 The word ‘asphyxia’ is derived from Greek and means ‘stopping of the pulse’. Asphyxia is

22 defined as a clinical syndrome with hypoxia and metabolic acidosis as a consequence of

23 hypoventilation [3]. The threshold of metabolic acidosis at delivery associated with

24 moderate or severe newborn complications is an umbilical arterial base excess (BE) of - 12

25 mmol/L. Increasing levels of metabolic acidosis are proportional to the severity of

26 newborn complications [4].

27 Methods

28 In 2013, using the institutional data of 2012, we performed an ‘extended perinatal audit’ in 29 the Jan Yperman Hospital (JYH) (Ieper, Belgium, a secondary level, teaching maternity),

30 including not only perinatal and maternal deaths, but also intrapartum asphyxia.

31 Intrapartum asphyxia is defined as an arterial umbilical cord blood pH $\leq$ 7.05 and a BE of

32 less than - 12 mmol/L (metabolic acidosis)[5]. Blood gas analysis was sampled according

to methodology of Huch et al [6]. Samples were collected immediately after birth and sent to the lab instantly for analysis. When BE was not available, we used a 5 minute Apgar score of less than or equal to 6 to establish the diagnosis of intrapartum asphyxia, as proposed by Bonnaeres et al [5]. Fetal heart rate patterns were classified according to the FIGO classification by one obstetrician (ID). In cases of doubt, a second obstetrician (GP) was consulted and a consensus was made. We performed a Pubmed search and used the following keywords: 'perinatal death', 'perinatal audit', 'perinatal asphyxia', 'intrapartum asphyxia', 'intrapartum death', 'preventable perinatal death', and 'neonatal near miss'.

Results

In 2012, 1168 children were born in JYH. The perinatal mortality rate in Flanders was 6.5 per thousand and 2.6 per thousand in JYH [7]. In absolute numbers, there were 3 perinatal deaths in JYH. Two were antenatal deaths and one early-neonatal. There were no maternal deaths. The total number of neonates born with an arterial umbilical cord pH of less than 7.05, was 45 (figure 1). In 31 cases the BE was known. Of these, 19 term neonates had metabolic acidosis, and thus intrapartum asphyxia. Ten were female, nine male. Seven had meconium stained amniotic fluid during labour. As accounts for the fetal heart rate (FHR) monitoring, one had a normal CTG, six had a suboptimal CTG, eight had an abnormal CTG, of which four had a significant ST event, and in four monitoring was lacking. Nine

51 neonates were born by vacuum extraction, two by secondary caesarean section, and eight
52 by spontaneous vaginal delivery. Of the four with significant ST event, two were born by
53 vacuum extraction, one by caesarean section, and one spontaneously. In total, four of the
54 19 newborns were admitted to the neonatal ward. In none of the cases there was antenatal
55 maternal or fetal morbidity. Two neonates were macrosomic (birth weight > p 90), three
56 were growth restricted (birth weight < p 10).

57 Of the 14 cases with unknown BE, seven had an Apgar of ≤ 6 after 1 minute, out of which
58 four an Apgar of ≤ 6 after 5 minutes. The latter had an arterial pH between 6.84 en 7.0.
59 Only one had meconium stained amniotic fluid, one had a terminal CTG, two an abnormal,
60 and one a suboptimal CTG. One baby was born at 36 weeks and 6 days, one at 37 weeks
61 and 3 days, and two at 38 weeks. In one of 38 weeks gestational age patients labour was
62 induced electively. Two neonates were growth restricted, amongst whom the one with the
63 terminal CTG. The latter was born by secondary caesarean section, had to be intubated,
64 and was transferred to a neonatal intensive care unit in a tertiary hospital. The other three
65 were admitted to the neonatal ward of JYH, two of who were born by vacuum extraction.

66 As accounts for the 10 neonates with pH < 7.05, unknown BE and with Apgar > 6 after 5

67 minutes, all were at term, one had a normal CTG, five had a suboptimal CTG of which one
68 with a significant ST event, one had an abnormal CTG, and three had no monitoring in the
69 second stage of labour. The one with the significant ST event was born in time by vacuum
70 extraction, had an arterial pH of 7.05, and required no admission to the neonatal ward.

71 Discussion

72 The aim of the extended internal perinatal audit in JYH is to identify preventable neonatal
73 deaths and cases of intrapartum asphyxia. To our knowledge, this modification of the
74 perinatal audit has been proposed in only one other article [5]. Andreasen et al also
75 highlight the importance of analyzing cases of birth asphyxia to identify causes of
76 substandard care [8]. Pileggi et al documented the possible usefulness of neonatal near
77 miss cases in improving quality of perinatal care. They used a broader concept of neonatal
78 near misses, including very low birth weight, gestational age of less than 30 weeks at birth,
79 and Apgar of less than 7 at 5 minutes [9]. Avenant equally proposes the inclusion of
80 neonatal near misses in the identification of deficiencies in care. He points out that there is
81 no current definition for neonatal near miss. Intrapartum asphyxia is considered one of the
82 components of neonatal near misses [10]. Once identified, it is important to reflect on how
83 these cases could have been prevented, and to arise awareness and improve current
84 practice. For all health care workers, it is a moment of self-reflection and a learning

opportunity. In JYH, cases of preventable intrapartum asphyxia are also discussed in the monthly "fetal monitor staff", which allows a short time interval from event-to-feedback, to ensure the maximum positive impact on practice. Regular training in FHR monitoring results in increased knowledge, better inter observer agreement, and improved quality of care [8]. Ideally, every member involved in the perinatal care process should attend the audit, thereby ensuring that all relevant information is considered, communication between health workers is facilitated, and consensus and a sense of participation of the recommendation is achieved. Confidentiality is important for ensuring a non-threatening atmosphere and open discussion among staff [2].

In 2012, there were no preventable perinatal deaths in JYH. There were two fetal deaths: an intra-uterine demise e causa ignota at 27 weeks 4 days and a foeticide at 31 weeks 5 days because of a large spina bifida. The neonatal death concerned one member of a dichorionic twin, which had a metabolic syndrome incompatible with life. Hence, analysis of perinatal deaths offered no data to help optimizing perinatal care.

After thorough analysis of the FHR monitoring patterns (with or without ST analysis), it ~~was thought that~~ three cases of the 19 metabolic acidosis cases were classified as preventable, and ~~that~~ four cases as definitively preventable (table 1). Of the 4 cases with pH $\leq$ 7.05, no known BE and Apgar $\leq$ 6 after 5 minutes, one was considered preventable. In total 8 cases were considered (possibly) preventable, this accounts for 6.85 per

104 thousand live births in 2012. All neonates with a pH ≤ 7.05 and an Apgar of > 6 after 5

105 minutes had a good outcome, confirming the relevance of the Apgar score.

106 Interpretation of FHR monitoring remains a critical point in preventing intrapartum

107 asphyxia. Unfortunately, interpretation of FHR monitoring is subject to intra- and inter

108 observer variability [11,12], which impedes its interpretation and consequently the

109 application of appropriate interventions. Hence, the value of CTG and ST analysis is still

110 under debate. CTG combined with ST analysis has a somewhat better intra- and inter

111 observer reproducibility and better specificity regarding pregnancy outcome than CTG

112 alone [12]. Computerized analysis has been suggested, but has not yet found widespread

113 introduction into clinical practice [12]. The Cochrane review on FHR monitoring

114 published in 2013, stated that there has been no proven benefit regarding number of

115 babies with metabolic acidosis at birth, babies with neonatal encephalopathy, babies with

116 low Apgar scores at five minutes, or babies requiring neonatal intubation. There were,

117 however, fewer operative vaginal deliveries and admissions to special care units [13]. As

118 most cases of cerebral palsy are not caused by intrapartum hypoxia, only a small portion

119 of cerebral palsy is possibly preventable by continuous FHR monitoring during labour

120 [11]. On the other hand, FHR monitoring (with or without ST analysis) is the only

technique that has been subjected to a series of randomized controlled trials demonstrating it to be at least as effective in reducing perinatal morbidity and mortality as structured intermittent auscultation which requires one-on-one nursing, a requisite not feasible in daily practice [14]. FHR monitoring has a high negative predictive value: a normal CTG is highly predictive for absence of metabolic acidosis [11]. Nevertheless, false negatives are reported with an incidence of 1.3% of acidosis [15]. If there is no indication to intervene on the basis of ST analysis, the recording should continue until delivery or at least within 20 minutes of delivery [12].

In two of the four preventable cases of proven metabolic acidosis, there was a significant ST event in the second stage of labour with birth respectively 15 and 35 minutes after the event. In the case where birth was effected 15 minutes later, FHR monitoring had been abnormal for more than one hour due to tachysystoly (more than 5 contractions in 10 minutes, averaged over a 30-minute window [16]). No intervention was taken to neutralize the tachysystoly, nor was a vacuum extraction performed to accelerate birth after the significant event. In the third case monitoring was stopped after a persistent bradycardia for 12 minutes. No operative delivery had been performed, the child was born 17 minutes after switching off the monitor. In the fourth case, a secondary caesarean

138 section was performed. There had been an abnormal CTG for nearly two hours, there was
139 a significant ST event after one hour and 50 minutes of abnormal CTG, the baby was
140 born 35 minutes later. Earlier intervention could ~~probably~~ have avoided metabolic
141 acidosis.

142 In two of the three possibly preventable cases of metabolic acidosis there was no
143 continued FHR monitoring for more than 45 minutes. In the third case there was an
144 abnormal CTG in the active second stage of labour, with loss of variability and
145 bradycardia, which lasted for 30 minutes. No vacuum extraction was performed. Earlier
146 intervention could ~~possibly~~ have prevented the metabolic acidosis. Fortunately, none of
147 the children with (possibly) preventable proven metabolic acidosis showed signs of
148 cerebral palsy.

149 The preventable case in the group of children with Apgar score ≤ 6 after 5 minutes was
150 the fetus with a terminal CTG. Intervention was delayed, though it must be said that it is
151 impossible to know for how long the fetal stress had been present and whether earlier
152 intervention could have prevented the resulting cerebral palsy.

It can be concluded that in three out of seven (possibly) preventable cases of proven metabolic acidosis, there was no continuous FHR monitoring during the second stage of labour, and in two cases the neonate was born more than 10 minutes after a significant ST event. We therefore infer that continuous monitoring is required during the active second stage of labour. Providing a scalp electrode to all babies with suboptimal monitoring allows adequate registration until birth. Contrary to the belief that monitoring in the active second stage of labour is facultative because of imminent delivery, the active second stage of labour is at high risk of fetal acidosis and requires a close follow-up of the FHR [15].

Moreover, we ~~can~~ conclude that the STAN guidelines need to be followed. If there is a significant ST event during the second stage of labour, delivery should follow within 10 minutes.

We recognize that possible intra- or inter observer variability is a weakness in our plea, nevertheless, this is day-to-day reality and we think the lessons drawn are generalizable. To minimize observer variability, we recommend intradisciplinary consultation in doubtful monitors, as well as periodic learning moments for all concerned health care personnel. Interpretation of CTG and STAN should be as accurate as possible in order to

provide appropriate action and good quality of intrapartum care. Our conclusions concur with the conclusions of Andreasen et al. In their national study, inadequate fetal monitoring was recognized as a main reason for birth asphyxia, as was lack of clinical knowledge and skills. They state that local and national audits of difficult obstetric cases can improve health outcome and should be performed regularly [8].

What our extended perinatal audit adds:

1. continuous FHR monitoring in active second stage of labour is mandatory

2. STAN guidelines should be followed meticulously

Conclusion

So far, a perinatal audit has been used to discuss perinatal deaths and maternal morbidity and mortality, to improve the quality of perinatal care. Integration of cases of intrapartum asphyxia and identification of flaws, may be a much better tool to achieve this goal. It allows us to identify where the system or health care workers fail, and to act accordingly. The lessons learned from the first 'extended perinatal audit' in our institution are that continuous fetal monitoring could prevent cases of intrapartum asphyxia, and that an appropriate treatment following significant ST events in the second stage of labour is mandatory. In our opinion, an extended perinatal audit offers more levers to improve perinatal care.

Declaration of interest

We declare there has been no support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work; no other relationships or activities that could appear to have influenced the submitted work.

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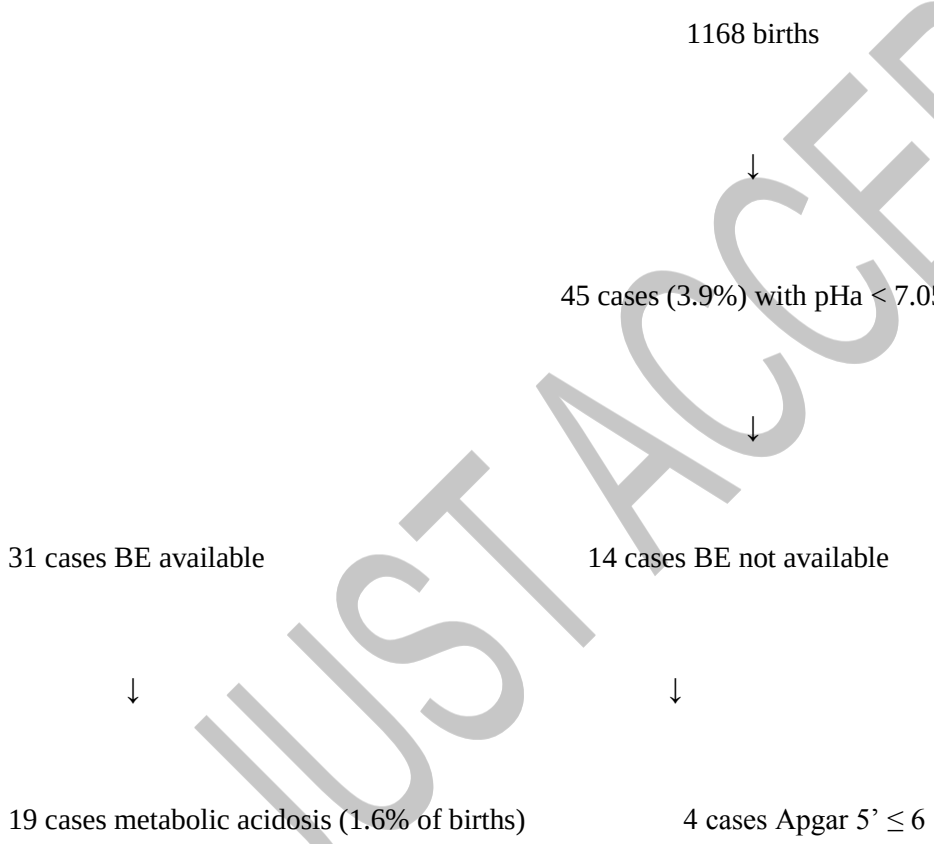
Figure 1: Cases of intrapartum asphyxia in 2012 at Jan Yperman Hospital, Ieper, Belgium



↓ ↓ ↓ ↓

4 preventable **3 possibly preventable** 12 not preventable **1 preventable**

Table 1: Preventable and possibly preventable cases of metabolic acidosis

gestational age	pHa	BE	Apgar 1’	Apgar 5’	mec	duration pushing	CTG second stage	ST event	operative delivery	neonatology admission	prevent able	reason (possibly) preventable
39+5	6.9	-14.9	4	6	N	42’	abnormal followed by 17’ no monitor	-	N	N	Y	**no monitoring, no operative delivery**
40+2	7.01	-14	9	10	Y	66’	abnormal	S	N	N	Y	**delivery > 5-10’ after event, no operative**

												delivery
39+2	6.94	-15.6	2	9	J	0’	abnormal	S	CS	Y	Y	**delayed intervention**
39+4	7	-16.6	9	10	N	30’	abnormal	S	V	N	Y	**delivery > 5-10’ after event**
40+2	6.93	-16.3	3	5	N	28’	abnormal	-	N	Y	P	**30 minutes bradycardia, no operative delivery**
41+2	7.01	-13.3	9	10	N	21’	-	-	V	N	P	**no monitoring**
40+1	7.05	-12.8	7	9	Y	28’	-	-	N	N	P	**no monitoring**

Legend table 1: pHa = arterial pH, BE = base excess, N = no, Y = yes, P = possibly, mec = meconium stained amniotic fluid

S = significant

V = vacuum extraction

CS = caesarean sectio